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U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS

Letter  
Circular  
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CONTROL OF HUMIDITY BY SATURATED SALT SOLUTIONS

In connection with the testing of organic protective coatings and other types of materials, the Bureau receives numerous requests for information on the use of saturated salt solutions to control humidity in inclosed spaces, for example, small cabinets. The purpose of this letter circular is to present general information on the subject.

Most saturated salt solutions exhibit rather large variations in humidity with temperature changes, hence, it is generally necessary to control temperature and to make certain that the air in the inclosed space is well mixed.

The following table gives the relative humidity of air in equilibrium over saturated solutions of various salts at temperatures that may be desired, together with some related information. It will be noted that in most cases the change in solubility with change of temperature is very large. The only salt with a solubility that remains almost constant over a range of  $30^{\circ}$  C is sodium chloride (NaCl). Therefore, this is the best salt to use for a relative humidity of about 75 percent.

Percentage Relative Humidities Over Saturated Salt Solutions

- Related Information -

No.	Solid phase	Temperature - degrees C				Other temperatures	Remarks on suitability for humidity control		
		10	20	30	40				
1	Lead nitrate $\text{Pb}(\text{NO}_3)_2$	a b	99.0% 30.8	98.2% 34.3	96.5 37.8	95.5 41.0	103.5° 88.4 158.	Solution slightly acidic due to hydrolysis - probably stable.	
2	Potassium sulfate $\text{K}_2\text{SO}_4$	a b	98.2% 8.44	97.1 10.0	96.6 11.5	96.1 13.17	102.1° 93. 24.	Excellent	
3	Potassium nitrate $\text{KNO}_3$	a b	95.1% 17.7	94.2 24.	92.5 31.4	89.4 39.1	110° 61.2 75.	Solution has large temperature coefficient, probably stable.	
4	Zinc sulfate $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$	a b	94.7% 34.	90. 35.	25° 88.5 36.7	84. 41.	Excellent below transition point - about 40° C.		
5	Potassium chromate $\text{K}_2\text{CrO}_4$	a b	88.1% 38.6	38.6 39.5	40.		Excellent - small temperature coefficient		
6	Potassium chloride $\text{KCl}$	a b	87.4% 23.8	85.3 25.6	84.5 27.2	82.8 28.7	100° 74.7 35.9	Excellent	

Note: The horizontal columns designated a = percentage relative humidity; b = solubility in grams of anhydrous salt per 100 grams of solution.

No.	Solid phase	Temperature - degrees C				Other temperature	Remarks on suitability for humidity control
		10	20	30	40		
7	Potassium bromide KBr	a b	86% 38.3	84.4	82.42	80.43.2	100° 69.2 51.2
8	Sodium chloride NaCl	a b	76.9% 26.3	75.8 26.38	75.1 26.5	74.4 26.65	100° 73.7 28.1
9	Cobalt chloride CoCl <sub>2</sub> ·6H <sub>2</sub> O	a b	18° 72.5% 49.7	67.3 52.	61.9 55.	56.6 58.	55° 49 61.7
10	Sodium dichromate Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> ·2H <sub>2</sub> O	a b	63.	52% 64.3	66.3	68.8	Good up to 55° - Transition point. Large temperature coefficient.
11	Calcium nitrate Ca(NO <sub>3</sub> ) <sub>2</sub> ·4H <sub>2</sub> O	a b	66.% 48.2	56. 54.8	51. 59.5	46. 67.	Excellent - low temperature coefficient.
12	Potassium carbonate K <sub>2</sub> CO <sub>3</sub> ·2H <sub>2</sub> O	a b	47.% 51.2	18.5° 44. 52.5	24.5° 43. 53.2	40. 53.9	Good up to 42.4° C. Excellent.
13	Magnesium chloride MgCl <sub>2</sub> ·6H <sub>2</sub> O	a b	34.7% 34.9	33.1 35.3	31.7 36.	31.3 36.5	Satisfactory

References

International Critical Tables, Vol. I, pp. 67 and 68.

For information as to equipment for temperature and humidity control using saturated solutions of some of the materials listed in the above table, see Physical and Chemical Examination of Paints, Varnishes, Lacquers, and Colors, by Henry A. Gardner, Ninth Edition, pages 92-97.